APPARATUS AND METHOD FOR GAS SENSING

FIELD OF INVENTION

The invention relates to an optical fibre delivery system for apparatus and method for sensing properties of a gas such as concentration or temperature by reference to the attenuation of light passing through the gas (trace gas sensing).

SUMMARY OF INVENTION

In broad terms in one aspect the invention comprises apparatus for remote gas sensing comprising a photodetector and a gas cell containing a gas or zone through which the gas passes and through which light from a light source passes and is reflected back to the photodetector, wherein the light source and photodetector, and the gas cell, are connected by a single polarisation preserving optical fibre through which light from the source passes to the gas cell, with light reflected back from the cell passing back through the optical fibre with a different polarisation to the transmitted light.

In one form the apparatus of the invention more specifically comprises a light source, a gas cell or zone, a photodetector to receive light reflected back from the gas cell, a single polarisation preserving optical fibre connecting the light source and photodetector to the gas cell, means to polarise return light exiting the gas so that it re-enters the optical fibre polarised orthogonal to the transmitted light, and means at the other end of the optical fibre to split the return light from the transmitted light and direct the return light to the photodetector.

In broad terms in another aspect the invention comprises a method for remote gas sensing utilising a photodetector and a gas cell or zone containing the gas or through which the gas passes and through which light from a source passes and is reflected back to the photodetector, including passing light from the source to the gas cell and back to the photodetector via a single polarisation preserving optical fibre such that the return light passes through the optical fibre with a different polarisation to that of the transmitted light.

In the apparatus and method of the invention the light source and photodetector are connected to the gas cell or zone via an arrangement including a polarisation preserving optical fibre which carries the transmitted and reflected light with different polarisations, which enables the photodetector and gas cell or zone to be remotely positioned from one another. The photodetector and associated electronics do not need to be positioned close to the gas cell or zone. The use of different polarisation for transmitted and reflected light eliminates unwanted optical interference, and enables separation of reflected from transmitted light for optical detection.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawing schematically illustrates one preferred arrangement of gas sensing apparatus, by way of example.

DETAILED DESCRIPTION OF PREFERRED FORM

Light from a source such as a laser passes through a polarising beam splitter 1 which is oriented to linearly polarise the light parallel to one of the two polarisation maintaining axis of a polarisation preserving single-mode optical fibre 2. The light is launched into the polarisation preserving fibre by a lens 3, and propagates through the optical fibre maintaining its polarisation state.

Upon exiting the fibre, the light is collimated by a second lens 4, and propagates through a gas sample region or cell 5, in a double pass configuration using a quarter-wave retarder 6 and retro-reflecting mirror 7. Some of the light is absorbed by the gas as it propagates through the gas ample, and this is used to determine properties of the sample, such as concentration and temperature.

Quarter-wave retarder 6 is oriented to change the polarisation state of the transmitted light from linear to pure circular. After retro-reflection by the mirror 7, the return light then passes back through the quarter-wave retarder 6, which changes the polarisation state of the light from circular back to linear, but with an orientation perpendicular to that of the forward propagating (transmitted) light. The mirror 7 is aligned so that the reflected light is launched back into the fibre, but because it is linearly polarised perpendicular to the forward propagating light, the

reflected light is polarised parallel to the other polarisation preserving axis of the optical fibre. This means that the forward and retro-reflected light propagates simultaneously through the optical fibre, but they have orthogonal linear polarisation states.

Upon exiting the fibre, the retro-reflected light is separated from the forward propagating light by the polarising beam splitter 1, and directed to the photodetector where its intensity is measured.

The preferred form illustrated is described by way of example. Alternative arrangements utilised in the concept of the invention are possible. For example in an alternative arrangement light exiting the optical fibre may be allowed to diverge by removing the collimating lens 4, and then retro-reflected using a spherical mirror placed a small distance equal to the radius of curvature of the mirror. In addition, separate optical components may be replaced by thin film or optical fibre based elements.

The gas sample region or cell 5 may be positioned in a hostile environment (for example hot or toxic), a cramped environment (for example within a compact machine), or a very distant location (for example on top of a smoke stack).

The foregoing describes the invention including a preferred form thereof. Alterations and modifications as will be obvious to those skilled in the art are intended to be incorporated within the scope hereof as defined in the accompanying claims.